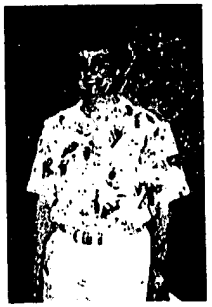
WPI WORCESTER POLYTECHNIC INSTITUTE

Biology & Biotechnology

Pamela J. Weathers
Professor



Education:

Marquette Univ. Milwaukee B.S. 1969 Biology
Michigan State Univ. Ph.D. 1974 Botany/Plant Pathology
MSU/DOE Plant
Research Lab

Courses Currently Taught:

- BB 1040 Plant Diversity
- BB ____ Plant Morphology & Development
- BB 4070 Separation of Biological Molecules
- BB 560 Protein Purification and Downstream Processing
- BB 570 Advanced Plant Physiology

Research Interests:

- Bioreactor culture of transformed roots
- Bioreactors for micropropagation
- Biology of hairy roots and secondary metabolite metabolism especially for sesquiterpene production in *Artemisia annua*
- Interdisciplinary Plant Research Group (IPRG)

Description of Current Research Program

Whereas the breadth of my research has always been on plants, my focus has shifted over the years towards plant related bioprocesses. Specifically, I am most interested in the study and development of bioprocesses related to economical production of plants or their products for ultimate commercial use.

Sesquiterpene Production from Transformed Roots:
A reliable supply of the antimalarial, sesquiterpene, artemisinin (AN), at a reasonable cost, requires large scale culture of high yielding tissue with high productivity rates. Successful scale-up requires significant research at the bench-scale. Media formulation studies are needed to achieve rapid biomass accumulation. At the same time, conditions to optimize AN biosynthesis must be measured. Projects are underway to measure and control peroxidase activity as one of the main degradative factors in production. Likewise, studies on the key biosynthetic control points in the pathways leading to artemisinin are also underway. It is likely that conditions that stimulate rapid biomass production will adversely affect AN biosynthesis. Understanding trade-offs is important because this will determine the overall culture production strategy.

Culture of Transformed Roots:
Secondary metabolites currently have an annual market > $20 billion worldwide. The nutrient mist bioreactor (NMB) uses a mist (nominally 7-10 microns droplet diameter) to feed the plant tissues rather than immersing the biomass in a liquid. This approach offers good aeration and control of the gas phase composition, eliminates shear damage and reduces chemical gradients within the reactor.

We have developed mathematical models for the key transport processes in the reactor and tested the validity of the models on a fully instrumented NMB using live roots. Kinetics of growth and secondary metabolite production in the NMB are being compared to other promising bioreactors for culture of transformed roots. We are using molecular probes and biochemical assays to determine what the roots are perceiving as they are grown in different reactors under different conditions.

Micropropagation:
Micropropagated plant tissues can be effectively cultured using the nutrient mist bioreactor (NMB). Recently, we demonstrated the use of an acoustically transparent material, one with an impedance equal to that of tissue culture media, as a possible solution to this design problem. We have proved the concept and developed and tested a very inexpensive version of the NMB that incorporates off-the-shelf items (e.g. Rubbermaid containers). We are now measuring the biological responses of micropropagated plants to varied mist/gas environments, and compariing the responses to more traditional culture methods. These results will be especially useful for the agricultural biotechnology community which is dependent upon micropropagation for clonal propagation of elite genotypes of important horticultural, medicinal and food plants.

Selected Recent Research Papers:

- Teoh, K., **Weathers, P.**, Walcerz, D., Cheetham, R., 1996. "Cryopreservation of Transformed Roots of *Artemisia annua L.*" *Cryobiology*. 33:106-117.

- Buer, CS, Correll, MJ, Smith, TC, Towler, MJ, **Weathers, PJ**, Nadler, M, Seaman, J, Walcerz, D. 1996. "Growth of Plant tissue in an Inexpensive Nutrient-mist Bioreactor with an Acoustic Window." *In Vitro*, 32:299-304.

- Smith, T.C., **Weathers, P.J.**, Cheetham, R.D., 1997. "Effects of Gibberellic Acid on Hairy Root Cultures of *Artemisia annua*: Growth and Production." *In Vitro Plant* 33: 75-79.

Pamela J. Weathers

- Wyslouzil, B.E., Whipple, M., Chatterjee, C., Walcerz, D.B., **Weathers, P.J.**, Hart, D.P., 1997. "Mist Deposition onto Hairy Root Cultures: Aerosol Modeling and Experiments." *Biotechnol. Prog.* 13: 75-79.

- Chatterjee, C., Correll, M., **Weathers, P.J.**, Wyslouzil, B.E., Walcerz, D.B., 1997. "A Simplified Acoustic Window Mist Bioreactor." *Biotechnol. Techniques* 11: 155-158.

- Buer, C.S., Gahagan, K.T., Swartzlander, G.A., **Weathers, P.J.** 1998. Insertion of Microscopic Objects Inside Plant Cell Walls Using Laser Microsurgery. *Biotechnology & Bioengineering*, 60:348-355.

- Wobbe, K., Zhang, X. and **Weathers, P.J.** 1998. Correlations between peroxidase activity, calcium, and artemisinin levels in hairy roots of *Artemisia annua.* In: Radical Biology: advances and perspecives on the funtion of plant roots. (ed. H.E. Flores, J.P. Lynch, D. Eissenstat, Am. Soc. Plant Physiologists, Rockville, MD) pp.432-434

- Souret, F., **Weathers, P.** 208.208.7.95Crocus sativus L. (saffron): Cultivation, *in vitro* culture, secondary metabolite production and phytopharmacognosy. J. Herbs Spices, and Medicin. Plants, in press.

- Buer, C.S., Gahagan, K.T., Swartzlander, G.A. **Weathers, P.J.** 1998. Differences in optical trapping prompt investigations of *Agrobacterium* surface characteristics. J ind. Microbiol., 21:233-236.

- **Weathers, P.J.** Wyslouzil, B.E., Wobbe, K.K., Kim Y.J., Yigit, E. 1999. The biological response of hairy roots to O2 levels in bioreactors. In Vitro Plant, accepted.

- **Weathers, P.J.**, Zobel, R.D. 1992. Aeroponics for the culture of organisms, tissues, and cells. Biotechnology Advances 10:93-115

- **Weatheres, P.**, Whipple, M. Wyzlouzil, B. 1997. Laboratory-Scale Studies of Nutrient Mist Reactors for Culturing Hairy Roots, In: Hairy Roots (ed. P.M. Doran, Gordan and breach/Harwood Academic, UK). Pp. 191-200

Contact Information:

Department of Biology & Biotechnology
Worcester Polytechnic Institute
100 Institute Road
Worcester MA 01609-2280
Phone: 508-831-5196
Fax: 508-831-5936
weathers@wpi.edu

bio-web@wpi.edu
Last modified: Wed Apr 14 10:13:23 EDT 1999